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lighter at the centre and sometimes powdery. The margin is irregular, and in the older specimens is torn. Below it is a sooty-brown or black, very granulate and deep pitted, has no fibrils. The apothecia are small and clustered in the spaces between the pustules, near the margin of the thallus. This species is found on rocks throughout the Eastern and Southern states, especially in the mountains.

UMBILICARIA PUSTULATA (L.) Hoffm. Plate IX. 3. Thallus small to medium, one-leaved, very papulous; in color ashy becoming brown, lighter at the centre and more or less powdery. In young specimens the margin is entire and slightly waved, as the plant grows older the margin breaks and appears ragged. The under surface is brown, growing lighter toward the centre; is finely granulate with deep pits. The apothecia are small and numerous, situated between the pustules of the thallus and toward the margin. The variety, *papulosa*, is so nearly like the specimens in appearance and internal structure that many lichenists include it with *pustulata.*

U. pustulata resembles *U. Pennsylvanica* very closely on the upper surface, except that in the latter the pustules are more irregular in outline, and are depressed at the centre. Beneath they are easily distinguished. *U. Pennsylvanica* is a sooty-black and is much more granulate than *U. pustulata* and the pits are not so marked.

RADULA.

By WM. C. BARBOUR.

(Continued from page 47. May, 1902.)

KEY.

1. Leaves closely imbricate (somewhat distant in *R. tenax*)........2.
   Leaves loosely imbricate....................................7.
   Leaves distant..................................*R. obconica.*
2. Stems dichotomously branching.......................*R. tenax.*
   Stems more or less pinnately branching...................... 3.
3. Mouth of perianth entire or nearly so.......................4.
   Mouth of perianth emarginate or crenate.....................6.
4. Perianth compressed, not noticeably narrowed at apex..........5.
   Perianth subinflated, narrowed at apex..............*R. Hallii.*
5. Perianth short, oblong-quadrate................*R. Caloosiensis.*
   Perianth long, obconic........................*R. complanata.*
6. Perianth compressed cylindric.....................*R. australis.*
   Perianth funnel-form, mouth compressed..........*R. Xalapensis.*
7. Leaves flaccid, rotund oval, subrepand-dentate....*R. Sullivantii.*
   Leaves subascending or semivertical, broadly obovate, entire.
   R. Bolanderi.

RADULA TENAX Lindb. (*R. pallens* Sulliv.)

This species is found mostly in mountain regions, ranging from the Catskills of New York to the mountains of North Carolina. It is dioicous, with firm, rigid stems; the leaves rather remote, slightly, if at all, decurrent, elliptic ovate. The cells are rounded and very full of chlorophyll. The lower lobe is round-ovate, hardly half as wide as the stem. The antheridial spike is long-linear, obtuse, and is borne on the side of the stem below the fold of the leaf. The species occurs on rotten trunks, and is not often found.

RADULA AUSTRALIS Austin.

This is a small species occurring in the South (Georgia and Florida). The plants are prostrate, sparingly branched and loosely cæspitose. The leaves are somewhat decurrent, and the lower lobe is adnate to the stem along its inner margin. The perianth is long, compressed, and cylindric with an obconic or pear-shaped base. The mouth is bilabiate and emarginate or crenate. The antheridial spikes are short and broad, and are found on the branches.

RADULA CALOOSIENSIS Aust.

This species was found by Austin himself near Caloosa, Florida, and accordingly has received its specific name from this place. The stems are short and sparingly branching. The leaves are entire or sometimes obscurely crenate, the margins very often bearing gemmæ. The lower lobe is large and either acuminate or obtuse, and has its inner margin adnate to the stem. The perianth is short, broadly oblong-quadrate from an obconic base; and is strongly compressed. It is bilabiate, with the lips entire, their margin decurved. Antheridial spikes are long and loose.

RADULA HALLII Aust.

This species was very briefly described by Austin from material collected by Hall at Salem, Oregon, and named for the collector. In many ways, such as size, perianth and general appearance, it is much like *R. complanata*, but has its perianth larger, elliptic-oblong instead of obconic, and narrowed at the apex. The mouth of the perianth is sometimes fleshy.

RADULA XALAPENSIS Mont.

This is another species which occurs in the South, collections having been made on wet rocks at Tallulah Falls, in Georgia, by Sullivant and Lesquereux, and at Toccoa Falls, Georgia, by Underwood. The stems are closely pinnately branched, and somewhat flaccid. Leaves are orbicular, obtuse, and closely imbricated. The lower lobe is broad, nearly round, and has an undulate margin. The base is somewhat adnate to the stem. The perianth occurs either on terminal or lateral branches, and is long funnel-form with mouth compressed and slightly crenate.

RADULA SULLIVANTII Aust.

Again a Southern species, having been collected in Georgia by Sullivant, Lesquereux, and Underwood.

The stems are closely cæspitose, with short, spreading branches. Leaves loosely imbricate, round-oval, more or less decurved at the apex, with subrepand-dentate margin. The lower lobe is somewhat inflated at the apex, usually obtusely triangular, with the inner margin adnate to the stem, and parallel to it.

RADULA BOLANDERI Gottsche. (*R. spicata* Aust.)

Plants slender, becoming cæspitose. Stems are short, with short, pinnately-arranged branches. The leaves are loosely imbricate, obovate, with obtusely rounded apex. Lower lobes ⅓ the size of the upper, inflated, rhomboid ovate, with apex usually appressed to upper lobe. Antheridial spikes numerous, linear, and directed downward.

The perianth is obconic, bilabiate, with margin of lips entire. *R. Bolanderi* is found in the Coast Range Mountains from San Francisco to Vancouver Island. Dr. M. A. Howe states (Mem. Torr. Bot. Club, **7**:159, 1899,) that there seems to be little or nothing in the description or figure of *R. arctica* Steph. to distinguish it from young plants of *R. Bolanderi.*

The species is figured in Pearson's List Can. Hep. 4. *pl. 4.* 1890, as *R. spicata.*

RADULA OBCONICA Sulliv.

This is a Northern species, occurring rarely from Ohio to New Jersey, on trees in cedar swamps. The stems branch undeterminately; the leaves are distant, round-ovate. The perianth is rather obconic to clavate, with mouth obliquely truncate and entire. The genus Radula occurs more abundantly in the tropics than in temperate regions. Schiffner (Conspectus Hep. Arch. Indici, 1898) reporting twenty species from the islands of Java and Sumatra alone. Much work needs to be done in collecting American forms and determining the range of species.

Sayre, Pa.

THE PERISTOME. IV.

By A. J. GROUT.

So much space in this issue is taken by the concluding article on nomenclature that only a few additional notes on species previously treated will be given here.

Prof. F. E. Lloyd, of the Teachers' College, New York City, showed the author an unusually pretty experiment with the spore distribution of Polytrichum. He took a fully matured capsule from which the operculum had recently fallen and which was still nearly filled with spores; holding this up to the light with the mouth of the capsule toward him and the lower end of the seta grasped in the left hand, he twanged the seta *a la guitar* so as to give the capsule short, sharp shakes. The epiphragm then appears as a translucent membrane and the mass of spores can be seen rolling up against its lower edge like sawdust in a drum, while they escape in clouds from the openings between the teeth.

With respect to spore distribution in the Buxbaumiaceae, Prof. Lloyd calls attention to the statements of Prof. Goebel that in *Webera sessilis* the flattening of the capsule on the dorsal side is useful, not alone for light absorption but also for spore dispersal. Drops of rain strike this flattened upper surface and by their impact force out a puff of spores from the nozzle-like peristome. The capsules are really minute powder guns all set for action. If a fresh mature deoperculate capsule be given a slight tap with